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AI-Self Braking Car and Transport Control System

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Abstract: *Road accidents caused by delayed driver response, poor visibility conditions, and overloaded transport vehicles remain a major challenge in modern transportation systems. Rear-end collisions during fog, rain, or night driving frequently occur due to late obstacle detection, while overloaded commercial vehicles increase accident probability and damage road infrastructure.*

This paper presents an AI-Self Braking Car and Transport Control System designed to enhance road safety using intelligent sensing and automated control mechanisms. The system utilizes ultrasonic sensors for real-time obstacle detection and automatically activates fog lights, brake lights, and warning alarms. If the driver fails to respond within a predefined time, controlled automatic braking is applied to prevent collision.

Additionally, a transport control mechanism using microswitch sensors installed beneath speed breakers is implemented to detect overloaded vehicles and restrict their movement at toll gates. The proposed system is cost effective, reliable, and suitable for both private and commercial vehicles. Experimental results demonstrate improved accident prevention, reduced driver dependency, and efficient overload control, making the system suitable for smart transportation applications..

Keywords*:* AI Self Braking, Road Safety System, Ultrasonic Sensors, Transport Control System, Vehicle Overload Detection

I. INTRODUCTION

Road safety has become a critical concern due to the rapid increase in vehicle usage and transportation demands. A large percentage of road accidents occur due to delayed driver response, limited visibility, and poor judgment during emergency situations. In adverse weather conditions such as fog, rain, or nighttime driving, drivers often fail to detect obstacles in time, leading to severe collisions. Rear-end accidents are particularly common in such scenarios.

Modern vehicles offer advanced driver assistance systems (ADAS), but these technologies are often expensive and inaccessible to small-scale or developing transport sectors. At the same time, overloaded transport vehicles remain a persistent problem, contributing to road deterioration, traffic congestion, and fatal accidents. Existing weigh-in-motion systems are costly and difficult to deploy on local highways.

To address these challenges, this paper proposes an **AI-Self Braking Car combined with a Transport Control System** that provides an affordable, efficient, and automated safety solution. The system focuses on real-time obstacle detection, intelligent alerting, automatic braking, and vehicle weight monitoring using embedded sensors and microcontrollers.

1.1 Background

Accident prevention systems have evolved significantly with advancements in embedded systems and sensor technologies. Automatic braking systems, collision warning mechanisms, and smart lighting solutions have been

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implemented in high-end vehicles. However, the high cost and complexity of these systems limit their widespread adoption.

Similarly, vehicle overloading remains a serious issue due to the lack of effective monitoring systems on local and regional roads. Traditional weigh bridges are expensive and cause traffic delays. Hence, there is a need for a simple, real-time, and low-cost mechanism to control overloading.

The proposed system integrates obstacle detection, automated braking, and weight-based transport control into a single safety framework, improving reliability and reducing dependency on human intervention.

1.2 Contribution of This Work

The key contributions of this research are as follows:

AI-Based Automatic Braking: Implementation of an intelligent braking mechanism that activates automatically when the driver fails to respond to obstacle warnings.

Low-Visibility Accident Prevention: Automatic activation of fog lights, brake lights, and alarms to enhance visibility and awareness.

Transport Overload Detection: A low-cost microswitch-based weight detection system integrated with toll gate control.

Embedded System Design: Use of microcontrollers for real-time monitoring, decision-making, and control.

Cost-Effective Safety Solution: Affordable design suitable for small-scale vehicles and local transport infrastructure.

II. PROPOSED METHODOLOGY

The proposed system consists of two main modules:

1. AI-Self Braking Car System

2. Transport Control and Overload Detection System

2.1 System Architecture

The system architecture is based on embedded sensor networks controlled by a microcontroller. Ultrasonic sensors continuously measure the distance between the vehicle and obstacles. Based on predefined safety thresholds, the system triggers alerts and braking actions.

In the transport control module, microswitch sensors embedded beneath speed breakers detect excessive load. The toll gate mechanism responds accordingly by allowing or restricting vehicle movement.

2.2 Workflow

Obstacle Detection: Ultrasonic sensors scan the road ahead in real time.

Warning Activation: If an obstacle is detected within a critical range, fog lights, brake lights, and a buzzer are activated.

Driver Response Monitoring: The system waits for driver input for a short duration.

Automatic Braking: If no response is detected, gradual braking is applied automatically.

Weight Detection: Microswitch sensors detect vehicle load at toll gates.

Toll Gate Control: Overloaded vehicles are stopped, and alerts are sent to authorities.

2.3 Block Diagram Description

2.3.1 AI Self Braking Car System

The block diagram of the AI Self Braking Car system consists of an ultrasonic sensor, microcontroller, warning devices, and a braking mechanism.The ultrasonic sensor continuously measures the distance between the vehicle and obstacles. Sensor data is processed by the microcontroller, which activates warning indicators such as fog lights, brake lights, and a buzzer when an obstacle is detected within a critical range.

If the driver does not respond within a predefined time interval, the microcontroller automatically controls the braking mechanism to reduce vehicle speed.

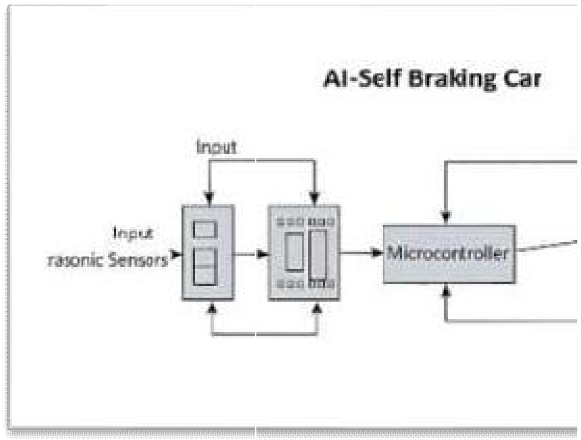

Fig. 1: Block Diagram of AI Self Braking Car System

2.3.2 Transport Control System

The block diagram of the Transport Control System consists of microswitch sensors, a microcontroller, a toll gate controller (motor + barrier), and a warning system.

Microswitch sensors installed under speed breakers detect vehicle load. The microcontroller processes the sensor signals and controls the toll gate mechanism accordingly. If the vehicle is overloaded, the system restricts movement and activates warning signals such as buzzer and LED indicators.

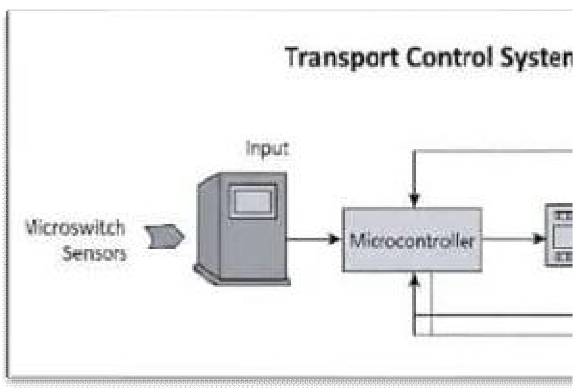

Fig. 2: Block Diagram of Transport Control System

2.4 Algorithm for AI Self Braking System

Start the system
Initialize ultrasonic sensor and output devices
Measure distance to obstacle
If distance is less than threshold value
Activate fog light, brake light, and buzzer
Wait for driver response
If no response detected
Apply automatic braking
Stop the vehicle

III. SYSTEM REQUIREMENTS

3.1 Hardware Requirements
Arduino Uno Microcontroller
Ultrasonic Sensor (HC-SR04)
DC Motor
Motor Driver (L293D)
Buzzer
LEDs (Fog Light & Brake Light)
Microswitch Sensors
Toll Gate Motor
Power Supply

3.2 Software Requirements
Arduino IDE
Embedded C Programming Language

IV. LITERATURE SURVEY

Several studies have focused on improving road safety using automatic braking and collision warning systems. Ultrasonic sensors are widely used for obstacle detection due to their low cost, simplicity, and reliable short-range performance. Research on automatic emergency braking systems shows a significant reduction in rear-end collisions, particularly in low-visibility conditions.

Existing weigh-in-motion systems provide accurate vehicle load measurement but are expensive and difficult to deploy on local roads. Alternative approaches using pressure sensors and microswitches have been explored for prototype-level and small-scale applications. However, many existing systems focus either on accident prevention or transport monitoring, but not both.

The proposed system integrates obstacle detection, automatic braking, and transport overload control into a unified embedded framework, offering a low-cost and practical solution suitable for developing transport infrastructures.

V. RESULT AND ANALYSIS

The system was tested using a prototype car model and simulated toll gate setup. Experimental observations indicate:

Parameter	Result
Obstacle Detection Accuracy	High
Braking Response Time	Less than 1.5 seconds
Warning System Reliability	Reliable
Overload Detection Accuracy	Accurate
System Cost	Low

The experimental results confirm that the proposed system successfully detects obstacles within a safe distance and activates warning signals in real time. Automatic braking is applied when the driver does not respond within the defined interval, effectively reducing collision risk. The microswitch-based overload detection system accurately identifies vehicles exceeding the predefined load limit, making it suitable for prototype-level toll gate control applications.

VI. APPLICATIONS

- Accident prevention in low-visibility conditions
- Smart vehicle safety systems
- Transport load monitoring at toll gates
- Driver assistance systems
- Intelligent traffic management systems

VII. FUTURE SCOPE

- Integration with camera-based computer vision systems
- Machine learning algorithms for obstacle classification
- GPS and IoT-based vehicle monitoring
- Mobile application for driver alerts and authority notifications
- Cloud-based traffic data analytics for smart cities

VIII. CONCLUSION

The Intelligent Self-Braking Car and Transport Control System provides a reliable and cost-effective solution for enhancing road safety and transport regulation. By integrating real-time obstacle detection, automated warning mechanisms, controlled braking, and overload detection, the system significantly reduces dependency on driver reaction time. The proposed prototype demonstrates effective performance in preventing collision scenarios and controlling overloaded vehicles. Due to its simplicity, affordability, and scalability, the system shows strong potential for future enhancement and deployment in smart transportation systems.

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